GUIDE FOR ESTIMATING CONSTRUCTION COSTS

U. S. Department of Agriculture

Farmers' Home Administration

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This Guide has been prepared for the purpose of assisting those persons who are responsible for estimating construction costs.

The information in this Guide was obtained from the following sources:

Published books on estimating.
Guides for estimating construction from several state offices.
Experience as reported by state engineers in various state offices.

The labor hours as set forth in this Guide represent averages arrived at through consideration of the information on labor hours obtained from the above sources. Records of labor for construction work reveal wide variations in the labor requirements for the same type of work on different jobs. This is to be expected, due to the many factors which may influence the labor output on any one job. Since the labor hour figures in this Guide represent averages, the estimator in using the Guide should give due consideration to local conditions or other factors which might make the quantities inapplicable in any instance.

Factors to be taken into consideration which may alter the man-hours required for various construction operations are as follows:

1. Inadequate supervision or organization of work.
2. Labor unfamiliar with type of work.
3. Generally inefficient labor.
4. Work of greater complexity than usual in an average rural residence.
5. Substandard materials.
6. Salvage materials.
7. Weather.
8. Noncontinuous or piecemeal operations.

We have not included in this manual any figures on supervisory hours or supervisory costs. Figures on supervisory costs were intentionally omitted from the tables due to the extremely wide variations in this item, particularly as it applies to work as performed in our program. Likewise, no figures have been given for laying out excavation work, hauling materials to the job, or unloading materials at the site. We suggest that the above factors be covered by an over-all supervisory cost of approximately three percent.

EXCAVATION AND FILL

ESTIMATING QUANTITIES:

The unit of measure used in computing excavation is the cubic yard (cu.yd.). A cubic yard contains 27 cubic feet, therefore, the number of cubic yards of soil to be moved will be computed as follows:

(length x width x depth) divide by 27 = cu. yds.

In computing excavations for basements provide for excavating 2 ft. beyond outside face of foundation wall on all sides to allow for working space during construction.

When estimating the cubic yardage of trench excavation for foundation walls of basementless houses use for width of excavation, the following:

For shallow trenches (up to 2 ft. deep),use width of footings.
For trenches 2 to 4 ft. deep, use width of footing or 1'-6", whichever is greater.
For trenches 4 to 6 ft. deep, use 2'-0".

TABLE 1

VOLUME OF TRENCH EXCAVATION - CU. YDS. PER 100 LINEAL FEET OF TRENCH

Depth of Trench	Width of Trench						
	12"	14"	16"	18"	20"	22"	24"
12"	3.7	4.3	4.9	5.6	6.2	6.2	7.4
14"	4.2	5.0	5.8	6.5	7.2	7.9	8.6
16"	4.9	5.8	6.6	7.4	8.2	9.0	9.9
18"	5.6	6.5	7.4	8.3	9.3	10.2	11.1
20"	6.2	7.2	8.2	9.3	10.3	11.3	12.3
22"	6.8	7.9	9.0	10.2	11.3	12.4	13.6
2'-0"	7.4	8.6	9.9	11.1	12.3	13.6	14.8
2'-6"				13.9	15.4	17.0	18.5
3'-0"				16.7	18.5	20.4	22.2
3'-6"				19.4	21.6	23.8	25.9
4'-0"				22.2	24.7	27.2	29.6
4'-6"							33.3
5'-0"							37.0
5'-6"							40.7
6'-0"							44.4

EXCAVATION AND FILL

ESTIMATING LABOR HOURS AND COSTS:

The number of labor hours required for excavation will vary greatly depending upon the material being excavated. For the purpose of this Guide we have assumed ordinary medium soils. The number of labor hours should, therefore, be adjusted by the estimator whenever other than ordinary medium soils are encountered. Labor hours should be decreased for light soils such as light loam or sand and increased for heavy soils such as clay, hardpan, and rock.

Hand Labor	Labor Hours Per Cu.Yd.	Rate Per Hour	Cost Per Cu.Yd.
Trenches to 6 ft. deep	2	____	____
Pier or chimney pits	3	____	____
Basements	1.5	____	____
Stripping top soil	1.4	____	____
Backfilling or grading	.7	____	____
Machine Excavation			
Tractor, plow, and scraper	.08	____	____
Bulldozer	.03	____	____

GRAVEL FILL UNDER FLOOR SLABS

ESTIMATING QUANTITIES:

The following table may be used for determining the amount of gravel in cubic yards per 100 sq. ft. for various thicknesses of fill. Where the depth of fill is not constant over the entire area, use quantities shown in the line representing average thickness of fill.

TABLE 2

Cubic Yards of Gravel Required for 100 Sq. Ft. of Fill

Thickness of Fill	Cu. Yds. per 100 Sq. Ft.
4"	1.25
5"	1.55
6"	1.85
7"	2.15
8"	2.47
9"	2.78

GRAVEL FILL UNDER FLOOR SLABS

ESTIMATING LABOR HOURS:

	Labor Hours Per 100 Sq. Ft.
4" thick fill, spread, grade and tamp	1.5
6" " " " " " "	1.8
8" " " " " " "	2.0

ESTIMATING COSTS:

	Labor Hours or Quantity	Rate per Hour or Unit Cost	Cost	
4" Thick				
Gravel per 100 sq. ft.	1.25 cu. yds.	_____	_____	
Labor " " " "	1.5 hours	_____	_____	
			_____	Per 100 sq. f
			_____	Per sq. ft.
6" Thick				
Gravel per 100 sq. ft.	1.85 cu. yds.	_____	_____	
Labor " " " "	1.8 hours	_____	_____	
			_____	Per 100 sq. f
			_____	Per sq. ft.
8" Thick				
Gravel per 100 sq. ft.	2.47 cu. yds.	_____	_____	
Labor " " " "	2.0 hours	_____	_____	
			_____	Per 100 sq. f
			_____	Per sq. ft.

ESTIMATING QUANTITIES:

Roll Roofing 1-Ply:

Roll roofing when used as a vapor barrier under concrete floor slabs should have a minimum weight of 45 lbs. per roll. Roll roofing in weights of 45 lbs. and over per roll is sold in standard size rolls 36" wide and 38' long, containing 108 sq. ft. This standard size is based on 100 sq. ft. coverage with 2" edge lap and 6" end lap. Two-inch edge lap is not adequate when using this material as a vapor barrier on fill under concrete slabs; therefore, in estimating quantities for this purpose it will be necessary to increase the usual one roll per 100 sq. ft. as follows:

For 4" lap:

$$\text{No. of rolls required} = \frac{\text{Area of floor slab}}{100} \text{ plus 1.}$$

For 6" lap:

For areas up to 1000 sq. ft. - same as for 4" lap.

For areas over 1000 sq. ft.

$$\text{No. of rolls required} = \frac{\text{Area of floor slab}}{100} \text{ plus 2.}$$

Membrane Waterproofing 2-Ply:

Tar or asphalt saturated felt for membrane waterproofing is customarily sold in standard size rolls 36" wide containing 432 sq. ft. A two-ply application will require from 220 to 225 sq. ft. of felt for each 100 sq. ft. of floor area. Pitch or asphalt will be required at the rate of approximately 100 lbs. per 100 sq. ft. of waterproofing for three moppings.

ESTIMATING LABOR HOURS:

		Labor Hours
Roll roofing 1-ply (6" lap - laps cemented)	Per 100 sq. ft.	1
Two-ply membrane waterproofing - 3 moppings	" " " "	3

ESTIMATING COSTS:

1-Ply Roll Roofing 6" Laps Cemented	Labor Hours or Quantity	Rate per Hour or Unit Cost	Cost
Roofing per 100 sq. ft.	1.16 rolls	_____	_____
Labor " " " "	1 hour	_____	_____
			_____ Per 100 sq.ft.
			_____ Per sq. ft.

WATERPROOFING - CONCRETE SLABS ON GROUND

ESTIMATING COSTS: (Cont.)

2-Ply Felt - 3 moppings 6" Laps Cemented		Labor Hours or Quantity	Rate per Hour or Unit Cost	Cost
Felt	Per 100 sq. ft.	.52 roll	_____	_____
Pitch	" " " "	100 lbs.	_____	_____
Labor	" " " "	3 hours	_____	_____

_____ Per 100 sq.ft

_____ Per sq. ft.

CONCRETE WORK

ESTIMATING QUANTITIES:

Forms:

Side forms will not be required for footings except where soil conditions at footings depth are such that the banks are not self-supporting. Forms will be used for both sides of all foundation walls.

Experience indicates that for foundation walls up to 8 ft. in height, approximately 2 bd. ft. of lumber will be required for forms for each sq. ft. of contact surface.

Example: Estimate the sq. ft. of forms and bd. ft. of lumber for a poured concrete wall 40 ft. long x 6 ft. high. Since forms will be required for both sides, the sq. ft. of forms (contact area) will be obtained as follows:

Sq. ft. of forms = 40 x 6 x 2 = 480 sq. ft.
Bd. ft. of lumber = 2 x 480 = 960 bd. ft.
The bd. ft. of lumber would be broken down as follows:
1" boards 480 (contact area) plus 17 percent waste = 560 bd. ft.
2 x 4's 960 - 560 = 400 bd. ft.

Since in the majority of cases in our programs, material used for forms will be used later in the structure as studding, bridging, sheathing, or sub-flooring, it will not generally be necessary to include material costs when estimating costs of concrete forms.

ESTIMATING LABOR HOURS:

Erecting and removing wood forms		Labor Hours Carpenter	Labor Hours Helper
Foundation Walls	Per 100 sq. ft. of contact area	5	4
Columns and Piers	" " " " " " "	10	7.5
Steps	" " " " " " "	9	6

CONCRETE WORK

ESTIMATING QUANTITIES:

Reinforcing:

When estimating quantities of reinforcing bars, list the number of bars of different sizes and lengths and reduce the total to pounds. In taking off lengths of reinforcing bars for continuous reinforcement, allow for laps equal in length to 40 times the diameter of the bar.

Standard Sizes and Weights of Reinforcing Bars

Size	Weight in Lbs. per Ft.
1/4" round	.167
3/8" "	.376
1/2" "	.668
5/8" "	1.043
3/4" "	1.502

Wire mesh reinforcing of the type and gauge of wires most commonly used in our work may be purchased in widths (in multiples of the spacing of longitudinal wires) up to 8 ft. When estimating quantities of wire mesh, use the square foot as a unit of measurement calculating the area of the slab to within 1 in. of the edge. For slabs with dimension at right angle to the direction of longitudnal wires of not more than 8 ft. use the area as calculated. With this dimension in excess of 8 ft. add 10 percent for lap.

Weights of Welded Wire Fabric

Spacing	Wire Gauge	Wt. per 100 Sq. Ft.
4" x 12"	No. 6 x No. 6	41.6
4" x 12"	No. 8 x No. 8	29.6
6" x 12"	No. 4 x No. 4	43.8
6" x 12"	No. 6 x No. 6	31.8
6" x 6"	No. 6 x No. 6	42.0
6" x 6"	No. 8 x No. 8	30.0
6" x 6"	No. 9 x No. 9	25.0
6" x 6"	No. 10 x No. 10	20.7
4" x 4"	No. 6 x No. 6	61.9
4" x 4"	No. 8 x No. 8	44.1

ESTIMATING LABOR HOURS:

Reinforcing:

		Labor Hours
Placing Reinforcing Bars (No ties)	Per 100 lbs.	1
Placing Reinforcing Bars (Tied in place)	" " "	1.3
Placing Wire Mesh	Per 100 sq. ft.	.5

CONCRETE

ESTIMATING QUANTITIES:

Concrete:

Tables 3 and 4 are included for use in estimating quantities of concrete, and materials required for various concrete mixes.

TABLE 3

QUANTITIES - FOOTINGS, WALLS, AND SLABS

Footings		Walls		Floor Slabs	
Size	Cu. Yds. Per 100 Lin. Ft.	Thickness	Cu. Yds. Per 100 Sq. Ft.	Thickness	Cu. Yd Per 1 Sq. F
6" x 12"	1.85	6"	1.85	1"	0.31
6" x 16"	2.47	8"	2.47	2"	0.62
8" x 16"	3.29	10"	3.09	3"	0.93
8" x 20"	4.12	12"	3.70	4"	1.23
10" x 20"	5.14			5"	1.54
12" x 24"	7.41			6"	1.85

TABLE 4

APPROXIMATE AMOUNTS OF MATERIALS REQUIRED PER CUBIC YARD OF CONCRETE*

	Mix	Sacks of Cement	Cu.Yds. of Sand	Cu.Yds. of Gravel	Large Size Grave
Top Course of 2 Course Floors Concrete 1" to 2" Thick	1:1 3/4:2 1/4	7 1/2	.48	.61	3/8"
Dwelling Floors, Thin Reinf. Concrete 2" to 4" Thick	1:2 1/4:3	6	.50	.67	3/4"
Most Farm Construction	1:2:4	5 1/2	.41	.82	1 1/2
Porch and Barn Floors, etc.	1:2 1/2:3 1/2	6	.50	.70	1 1/2
Thick Sections Such as	1:2 1/2:5	4 1/2	.43	.85	1 1/2
Footings and Foundations	1:3:5	4 1/2	.50	.85	1 1/2

* Quantities shown above should be increased about 10 percent to allow for waste and variations.

CONCRETE

ESTIMATING QUANTITIES (Cont.):

Concrete (Cont.):

Example: Compute the quantity of concrete required in the construction of Farmhouse Plan No. H4-16:

Wall Footings 181'4" of 8" x 16" footings
From Table 3 we find that 100 lin. ft. of 8" x 16" footings will require 3.29 cu. yds. of concrete 1.8133 x 3.29 = 5.96 cu. yds.
Chimney Footings (One) 3'1" x 2'5" x 12" $\frac{3.08 \times 2.42 \times 1}{27}$ = .28 " "

Pier Footings (Two) 1'8" x 1'8" x 8" $\frac{1.67 \times 1.67 \times .67 \times 2}{27}$ = .14 cu. yds.

Total concrete for footings (1:3:5 mix) = 6.38 cu. yds.

Main floor and porches (Plan H4-16) 4" slabs

Floor slab area	24'6" x 33'2"	24.5 x 33.16 =	812.42 sq. ft.
Front porch area	8'0" x 16'8"	8.0 x 16.67 =	133.36 " "
Work porch area	12'0" x 12'8"	12.0 x 12.67 =	152.00 " "

Total area 4" slabs 1097.78 sq. ft.

From Table 3 we find that 1.23 cu. yds. of concrete are required for each 100 sq. ft. of 4" thick slab; therefore, 1098 sq. ft. of 4" floor slab will require 10.98 x 1.23 or 13.5 cu. yds.

The haunch at the edges of the front porch slab is approximately 6" x 12" by 31 ft. in length. From Table 3 .31 x 1.85 = .57 cu. yds.

The rear stoop is 3' x 4' x 10" volume = 3 x 4 x .83 divided by 27 = .37 cu. yds.

Total cu. yds. of 1:2 1/4:3 concrete 13.5 plus .57 plus .37 = 14.44 cu.yds.

Total concrete required for House Plan H4-16

1:3:5 concrete 6.38 plus approximately 10 percent for waste = 7 cu.yds.
1:2 1/4:3 concrete 14.44 plus " " " " " = 16 " "

If concrete is to be mixed on the job the required amounts of cement, sand, and gravel may be obtained by using values given in Table 4. Results should be rounded out to the nearest full sack of cement or tenth of a yard of aggregate.

CONCRETE

ESTIMATING QUANTITIES (Cont.):

Concrete (Cont.):

For 7 Cu. Yds. of 1:3:5 Concrete

Cement	7 x 4.5	=	31.5 sacks
Sand	7 x .5	=	3.5 cu. yds.
Gravel	7 x .85	=	5.95 cu. yds.

For 16 Cu. Yds. of 1:2 1/4:3 Concrete

Cement	16 x 6	=	96 sacks
Sand	16 x .50	=	8.00 cu. yds.
Gravel	16 x .67	=	10.72 cu. yds.

Total Requirements

Cement	31.5 plus 96	=	127.5 or 128 sacks
Sand	3.5 plus 8.0	=	11.5 cu. yds.
Gravel (largest size 1 1/2")			6.0 cu. yds.
Gravel (largest size 3/4")			10.5 cu. yds.

ESTIMATING LABOR HOURS:

Concrete Footings and Foundation Walls			Labor Hours Skilled	Common
Ready-Mixed	Placing	Per cu. yds.		2
Job Hand-Mixed	Mixing & Placing	" " "		4
Job Machine-Mixed	" " "	" " "		3
Concrete Floor Slabs				
3" THICK				
Ready-Mixed	Placing	Per 100 sq. ft.		2
Job Hand-Mixed	Mixing & Placing	" " " "		4
Job Machine-Mixed	" " "	" " " "		3
4" THICK				
Ready-Mixed	Placing	Per 100 sq. ft.		2.5
Job Hand-Mixed	Mixing & Placing	" " " "		5
Job Machine-Mixed	" " "	" " " "		3.7
Cement Finishing				
No topping				
Troweling directly on slab				
" with cement mortar topping		Per 100 sq. ft.	1.2	1.2
1/4" mixing, spreading, & troweling		" " " "	1.2	1.5
1/2" " " "		" " " "	1.2	1.7

CONCRETE

ESTIMATING COSTS:

Cost of 100 Lin. Ft. of 8" x 16" Concrete Footing

Job Hand-Mixed	Labor Hours or Quantity	Rate per Hour or Unit Cost	Total
Labor Excavating	6.6 hours	_____	_____
Cement	14.75 sacks	_____	_____
Sand	1.65 cu.yds.	_____	_____
Gravel	2.8 cu. yds.	_____	_____
Labor Mixing & Placing	13.2 hours	_____	_____
			_____ Per 100 lin. ft.
			_____ Per lin. ft.

Ready-Mixed			
Labor Excavating	6.6 hours	_____	_____
Concrete	3.3 cu.yds.	_____	_____
Labor Placing	6.6 hours	_____	_____
			_____ Per 100 lin. ft.
			_____ Per lin. ft.

Cost of 100 Sq. Ft. of 8" Concrete Wall

	Hours	Rate per Hour or Unit Cost	Total
Form Lumber* 234 bd. ft. 1" Sheathing		_____	_____
" " 166 " " 2 x 4's		_____	_____
Carpenter erecting forms	10	_____	_____
Helper erecting and removing forms	8	_____	_____
Concrete 2.47 cu. yds.		_____	_____
Labor placing concrete	5	_____	_____
Cost per 100 sq. ft.		_____	_____
Cost per sq. ft.		_____	_____

* Do not include the cost of materials for forms if this material is to be reused later as part of the structure.

CONCRETE

ESTIMATING COSTS (Cont.):

Cost of 100 Sq. Ft. of 4" Concrete Slab on Fill

Based on stripping 4" of top soil, grading, spreading, and tamping 6" of gravel fill, installing 1-ply 45 lb. roll roofing vapor barrier, and placing 4" thick ready-mixed concrete slab reinforced with 6" to 6" wire mesh.

	Hours	Rate per Hour or Unit Cost	Total
Labor strippin top soil and grading	1.75	_____	_____
Gravel for fill 1.85 cu. yds.		_____	_____
Labor - spreading and tamping fill	1.8	_____	_____
45 lb. Roll Roofing 1.08 rolls		_____	_____
Labor - placing vapor barrier	1.0	_____	_____
6" x 6" wire mesh #9 wires 110 sq. ft.		_____	_____
Labor - placing wire mesh	.55	_____	_____
Ready-mixed concrete 1.23 cu. yds.		_____	_____
Labor - placing concrete	2.5	_____	_____
Cement Finisher	1.2	_____	_____
Helper	1.2	_____	_____
Cost per 100 sq. ft.		_____	_____
Cost per sq. ft.		_____	_____

MASONRY

ESTIMATING QUANTITIES:

Concrete Block:

Number of Block Required.

When estimating the number of concrete blocks (7 3/4" x 15 3/4") required in the construction of a wall, compute the net area (gross area minus area of all openings)and multiply by 1.125.

Example: To determine the number of full-size concrete blocks required for a wall 7'4" high x 36' long, with two 2'0" x 2'8" window openings.

Gross area of wall = 7.33 x 36 = 264.00 sq. ft.
Deduct openings 2 x 2.67 x 2 = 10.67 " "
Net Area 253.33 " "

Number of blocks required = 253.33 x 1.125 = 285

The same number of blocks would be required for either a 4", 8", or 12" thick wall, provided that blocks are available in those thicknesses. In the case of 12" thick walls, if 12" thick blocks are not available, the wall may be constructed with 4" and 8" blocks, using 285 - 4" blocks and 285 - 8" blocks.

Quantities of Mortar Required.

In laying concrete blocks only the face shells are bedded in mortar. This is done in order to break the joints, thereby securing better resistance to penetration of moisture. The same amount of mortar will be required therefore per block for the same thickness of joint whether the blocks be 4", 8", or 12" thick. The following tables (Table 5 and Table 6) are for use in estimating quantities of materials required for mortar for concrete block walls.

TABLE 5

MORTAR REQUIRED FOR CONCRETE BLOCK WALLS

Joint Thickness	Cu. Yds. For 1000 Block
3/8"	1
1/2"	1.25
5/8"	1.5

TABLE 6

MATERIALS REQUIRED FOR 1 CU. YD. OF MORTAR

Mix (By Vol.)	Cement (Sacks)	Lime (Cu.Ft.)	Sand (Cu.Yds.)
1:3	9	-	1
1:1:6	4 1/2	4 1/2	1

Example: To estimate the quantities of cement, and sand required for a 1:3 mix of cement mortar required to lay 1500 - 7 3/4" x 15 3/4" face concrete blocks with a 3/8" thick joint.

From Table 5 Cu. yds. of mortar = 1.5 x 1 = 1.5

From Table 6 Sacks of cement = 1.5 x 9 = 13.5
Cu. yds. of sand = 1.5 x 1 = 1.5

MASONRY

ESTIMATING LABOR HOURS:

Concrete Block:

		Per 100 Pieces	Labor Hours Mason	Labor Hours Helper
Concrete Block Walls	8" x 8" x 16" units	"	5.5	5.5
" " "	8" x 8" x 12" "	"	5	5
" " "	4" x 8" x 16" "	"	4	4
" " "	4" x 8" x 12" "	"	3.5	3.4
Cinder Block Walls	8" x 8" x 16" "	"	5	5
" " "	8" x 8" x 12" "	"	4.5	4.5
" " "	4" x 8" x 16" "	"	3.5	3.5
" " "	4" x 8" x 12" "	"	3	3
Concrete Block Piers	8" x 8" x 16" "	"	6	6

ESTIMATING QUANTITIES:

Brick:

Number of Brick Required:

When estimating the number of brick required for walls, first calculate the net area (gross area minus area of all openings) of the wall in square feet. Do not count corners twice. The old standard size of common bricks is 8" x 2 1/4" x 3 3/4" and the number of brick per square foot of wall will vary with thickness of wall and thickness of mortar joint. Having computed the net area of the wall, the number of brick required may be calculated using the appropriate figures given in Table 7 below.

TABLE 7

NUMBER OF BRICK (8" x 2 1/4" x 3 3/4") REQUIRED FOR 100 SQ.FT. OF WALL)

Thickness of Wall	1/4" Vertical Joints			3/8" Vertical Joints			1/2" Vertical Joints		
	Horizontal Joints			Horizontal Joints			Horizontal Joints		
	1/4"	3/8"	1/2"	3/8"	1/2"	5/8"	3/8"	1/2"	5/8
4"	710	677	645	666	636	610	657	627	6
8"	1420	1354	1290	1332	1272	1220	1314	1254	12
12"*	2130	2031	1935	1998	1908	1830	1971	1881	18

Above figures include approximately 2 percent for waste.

* Use figures in this line for computing the number of brick required when the cubic foot is used as the unit of measure in taking off masonry work. The figures in this line represent the number of brick required per 100 cu. ft.

ESTIMATING QUANTITIES (Cont.):

Brick: (Cont.)

Example: Estimate the number of brick required for the foundation wall of a 24' x 36' house, wall to be 8" thick, 2'-8" high, with 4 - 8" x 16" vents, and 2' x 1'-6" access openings. Brick size 8" x 2 1/4" x 3 3/4", mortar joints 3/8" thick.

Gross area of wall	2 x 36 x 2.67 plus 2 x 22.67 x 2.67	=	313.30 sq. ft.
Deduct area of openings	4 x .67 x 1.33 plus 2 x 1.5	=	6.60 " "
		Net area	306.70 " "
From Table 7: 3/8" joints 8" wall	1332 x 3.067	=	4085 brick

When estimating the number of brick required for piers, columns, fireplaces and chimneys, compute the volume of masonry in cubic feet and use the values given in Table 7 in the line for 12" walls to compute the number of brick required. For example: Estimate the number of brick required in the construction of a 1' - 4 1/2" x 2'-1" brick chimney 19' high with two 8 1/2" x 8 1/2" flues. Bottom 2'-6" of chimney to be built solid. Brick to be 8" x 2 1/4" x 3 3/4" in size with 1/2" vertical and 3/8" horizontal mortar joints.

Gross volume	1.37 x 2.08 x 19	=	54.40 cu. ft.
Deduct volume of flue space	1.42 x .71 x 16.5	=	16.60 cu. ft.
	Net volume		37.80 " "

From Table 7: 100 cu. ft. of masonry laid with 1/2" vertical and 3/8" horizontal joints will require 1791 brick; therefore, 37.8 cu. ft. will require .378 x 1791 or 745 brick.

The following table (Table 8) has been prepared for use in estimating the number of brick required when modular sized brick are specified. Modular sized brick are being manufactured in 8" and 12" lengths and in varying thicknesses suitable for modular design based on a 4" module. Nominal thicknesses of 2" x 2 11/16", and 4" provide for construction with 4, 3, or 2 courses for each 8" (2 - 4" modules) vertically. The actual sizes of brick are 1/2" less in each dimension than the nominal size dimensions shown in the table to allow for 1/2" mortar joints.

TABLE 8

NUMBER OF BRICK (MODUIAR) REQUIRED PER 100 SQ. FT. OF WALL

Nominal Size of Brick	Thickness of Wall 4"	8"	12"
4" x 2" x 8"	918	1836	2754
4" x 2 11/16" x 8"	688	1376	2064
4" x 4" x 8"	459	918	1377
4" x 2" x 12"	612	1224	1836
4" x 2 11/16" x 12"	459	918	1377
4" x 4" x 12"	306	612	918

The above figures include approximately 2 percent for waste.

MASONRY

ESTIMATING QUANTITIES: (Cont.)

Brick: (Cont.)

Quantities of Mortar Required:

The quantity of mortar required in laying common brick will vary with size of brick used, the thickness of mortar joints and thickness of the wall. The quantities as given in Table 9 below should be accurate enough for estimating purposes. These quantities have been computed on the basis of using the common standard size of brick (8" x 2 1/4" x 3 3/4") and include approximately 10 percent allowance for waste.

TABLE 9

CUBIC YARDS OF MORTAR REQUIRED PER 1000 BRICK

Thickness of Joint	4" Veneer on Frame	Solid Masonry
1/4"	0.22	0.35
3/8"	0.35	0.48
1/2"	0.48	0.61
5/8"	0.56	0.75

ESTIMATING LABOR HOURS:

		Labor Hours	
		Mason	Helper
Common Brick:			
Walls 8" to 12" thick	Per 1000 brick	10	10
Small piers	" " "	13	13
Chimneys and fireplaces	" " "	16	16
Face Brick:			
As veneer or in solid masonry walls	Per 1000 brick	13	13
Fireplace - facing, hearth, lining and mantle	" " "	26	26
Flue Lining:			
8" x 8" or 12" x 12"	Per 10 lin. ft.	.7	.7

ESTIMATING QUANTITIES:

Rubble Stone:

Quantities of Stone Required:

The cubic yard containing 27 cu. ft. is commonly used as the unit of measure in computing quantities of rubble stone masonry. The number of cubic yards of rubble stone will be computed as follows:

(Length x width x height) divided by 27 = cu. yds.

ESTIMATING QUANTITIES: (Cont.)

Rubble Stone: (Cont.)

Quantities of Mortar Required:

The amount of mortar required for rubble stone work will vary with the size and shape of the stones and the care used in placing stones. Experience indicates that the amount of mortar required may vary from 6 to 13 cu. ft. per cu. yd. of masonry. For estimating purposes, mortar requirements may be computed on the basis of an average amount, or 9 1/2 cu. ft. per cu. yd. of masonry.

Example: To compute the stone and mortar requirements for the construction of a 1'-6" thick rubble stone wall 60' long x 6' high:

Stone (60 x 1.5 x 6) divided by 27 = 20 cu. yds.

Mortar 20 x 9.5 = 190 cu. ft. = 7 " "

ESTIMATING LABOR HOURS:

			Labor Hours	
			Mason	Helper
Foundation Walls	Random Rubble	Per cu. yd.	4	8
Random Ashlar Veneer		Per 100 sq. ft.	24	16

ESTIMATING COSTS:

8" Cinder Block Wall, 1/2" Mortar Joints

Per 100 Sq. Ft.		Hours	Rate per Hour or Unit Cost	Total
Cinder block	112.5 - 8" x 8" x 16" units		_____	_____
Masonry cement	1 1/4 sacks		_____	_____
Sand	1/7 cu. yd.		_____	_____
Mason		5.62	_____	_____
Helper		5.62	_____	_____
	Cost per 100 sq. ft.			_____
	Cost per sq. ft.			_____

MASONRY

ESTIMATING COSTS: (Cont.)

8" Concrete Block Wall, 1/2" Mortar Joints

Per 100 Sq. Ft.		Hours	Rate per Hour or Unit Cost	Total
Concrete blocks	112.5 - 8" x 8" x 16" units		_____	_____
Masonry cement	1 1/4 sacks		_____	_____
Sand	1/7 cu. yd.		_____	_____
Mason		6.2	_____	_____
Helper		6.2	_____	_____
	Cost per 100 sq. ft.			_____
	Cost per sq. ft.			_____

8" Wall, Brick Veneer with Cinder Block Back-up

Per 100 Sq. Ft.		Hours	Rate per Hour or Unit Cost	Total
Brick	645 - 8" x 2 1/4" x 3 3/4"		_____	_____
Cinder block	112.5 - 4" x 8" x 16" units		_____	_____
Masonry Cement	4 3/4 sacks		_____	_____
Sand	1/2 cu. yd.		_____	_____
Mason		12.32	_____	_____
Helper		12.32	_____	_____
	Cost per 100 sq. ft.			_____
	Cost per sq. ft.			_____

MASONRY

ESTIMATING COSTS: (Cont.)

8" Common Brick Wall, 3/8" Mortar Joints

Per 100 Sq. Ft.		Hours	Rate per Hour or Unit Cost	Total
Common brick	1332 - 8" x 2 1/4" x 3 3/4"		_____	_____
Masonry cement	5 3/4 sacks		_____	_____
Sand	.64 cu. yds.		_____	_____
Mason		13.3	_____	_____
Helper		13.3	_____	_____
	Cost per 100 sq. ft.			_____
	Cost per sq. ft.			_____

ROUGH CARPENTRY

ESTIMATING QUANTITIES:

The unit of measurement used in estimating quantities of lumber for rough carpentry is the board foot. One board foot of lumber is equivalent to a piece of lumber one inch thick, 12 inches wide and one foot long.

The following table may be used for computing the number of board feet in various sizes of boards and framing lumber:

TABLE 10

BOARD FEET OF LUMBER, PER LINEAL FOOT

Size	Bd. Ft. per Ft.	Size	Bd. Ft. per Ft.
1 x 2	0.166	2 x 2	0.333
1 x 3	0.25	2 x 3	0.5
1 x 4	0.333	2 x 4	0.667
1 x 5	0.417	2 x 6	1.0
1 x 6	0.5	2 x 8	1.333
1 x 8	0.667	2 x 10	1.667
1 x 10	0.833	2 x 12	2.0
1 x 12	1.0		

ESTIMATING QUANTITIES: (Cont)

The length to be used in computing the number of board feet required for framing lumber will be the nearest even dimension in feet from which the framing members may be cut. For example: if the finished length of a member is to be 9'-8", a 10'-0" length will be needed, and if the finished length is to be 10'-8", a 12'-0" length would be required.

Floor and Ceiling Joists:

To obtain the number of joists required, divide the length (in feet) of the floor by the joist spacing (in feet), and add one for the end joist. For floor joists, add one extra joist for each partition for which double joists are specified.

Example: To determine the number of joists required at 16" spacing for a section of floor 36 ft. long and supporting two partitions requiring double joists:

$$\text{Number of Joists} = \frac{36}{1.33} \text{ plus 1 (for end joist) plus 2 (for partitions)}$$

$$27 \text{ plus } 1 \text{ plus } 2 = 30$$

Joist Bridging:

One double row of bridging will be required in floor framing for joists with spans from 8 to 16 ft. Joists with spans of over 16 ft. will need double rows of bridging. Bridging is commonly cut from 1" x 3" or 1" x 4" lumber. Table 11 may be used for estimating the number of pieces of bridging and the approximate lineal and board feet of material required.

TABLE 11

NUMBER OF PIECES, APPROXIMATE LINEAL FEET AND BOARD FEET REQUIRED PER 100 FEET DOUBLE ROW BRIDGING

Size of Joist	Joist Spacing	No. of Pieces	Lineal Feet	Board Feet 1" x 3"	Board Feet 1" x 4"
2" x 6"	12"	200	208	52	69
"	16"	150	212	53	71
"	24"	100	206	52	69
2" x 8"	12"	200	229	57	76
"	16"	150	223	56	74
"	24"	100	210	53	70
2" x 10"	12"	200	255	64	85
"	16"	150	238	60	79
"	24"	100	233	58	78
2" x 12"	12"	200	279	70	93
"	16"	150	256	64	85
"	24"	100	243	61	81

ROUGH CARPENTRY

ESTIMATING QUANTITIES: (Cont.)

Rafters:

The number of rafters required may be obtained in the same method as used in estimating the number of joists. The lengths of rafters may be obtained from measurement of scale drawings or by computations based on rise and horizontal run. To facilitate computations, Table 12 below has been prepared setting forth the factor which, when multiplied by the horizontal run will give the length of rafter for various roof slopes.

TABLE 12

LENGTH OF RAFTERS

ROOF SLOPE	LENGTH IN FEET
3" in 12"	Horizontal Run x 1.031
4" in 12"	" " x 1.054
5" in 12"	" " x 1.083
6" in 12"	" " x 1.118
8" in 12"	" " x 1.202
10" in 12"	" " x 1.302
12" in 12"	" " x 1.414

The lengths computed in accordance with the factors in the above table are for rafters with the projecting end cut at right angles to the slope. Vertical end cutting of rafters will require increasing lengths by the amounts as shown in the following table:

INCREASE IN LENGTH OF RAFTER FOR VERTICAL END CUT

Roof Slope	Depth of Rafter				
	4"	6"	8"	10"	12"
3" in 12"	.08'	.11'	.15'	.19'	.24'
4" in 12"	.10'	.14'	.20'	.27'	.32'
5" in 12"	.12'	.19'	.26'	.33'	.41'
6" in 12"	.15'	.22'	.31'	.39'	.48'
8" in 12"	.20'	.31'	.42'	.53'	.64'
10" in 12"	.25'	.38'	.52'	.66'	.80'
12" in 12"	.30'	.46'	.62'	.79'	.96'

Example: To determine the length of rafters required for a 25'-8" wide house with a plain gable roof, roof slope 5" in 12", rafter overhang 1'-0" from outside of plate, and with rafter end cut vertically, 2" x 6" rafter:

Horizontal run of rafter = $\frac{25.66'}{2}$ plus 1' = 13.83'

From Table 12 13.83 x 1.083 = 14.98'
Increase for vertical end cut = .19'
Length of rafter 15.17'
Cut from 16'-0" length.

ESTIMATING QUANTITIES: (Cont.)

Stud Wall:

To obtain the number of studs required, divide the length of the wall (in feet) by the stud spacing (in feet) and add one for the end stud.

Example: To determine the number of studs required at 16" spacing for a wall 36' long:

$$\text{No. of studs} = \frac{36}{1.33} \text{ plus } 1 = 27 \text{ plus } 1 \text{ or } 28$$

Plates:

To obtain the number of lineal feet of top and bottom plates for walls having double top plates, multiply the length of the wall by three.

Example: To determine the number of lineal feet of plates for a wall 36' long having double top plates and single bottom plate:

Lineal feet of plates = 36.3 (1 for bottom plate and 2 for top plate = 72

From Table 10 this may be converted into board feet by multiplying by .667:

72 x .667 = 48 bd. ft.

TABLE 13

BOARD FEET OF LUMBER REQUIRED FOR STUD PARTITIONS
(2" x 4", 16" on center, 8' high, with double top plate & single bottom plat

Length of Partition	Bd. Ft.	Length of Partition	Bd. Ft.
3	22	12	77
4	30	13	84
5	36	14	92
6	44	15	94
7	46	16	101
8	53	17	108
9	61	18	116
10	67	19	117
11	70	20	125

ROUGH CARPENTRY

ESTIMATING QUANTITIES: (Cont.)

Wall Bridging (Solid Blocking):

To obtain the number of lineal feet of wall bridging, multiply the length of the wall by .9.

Example: To determine the number of lineal feet of wall bridging for a wall 36' long:

Lineal feet of bridging = 36' x .9 = 32.4

Subflooring & Sheathing:

TABLE 14

QUANTITIES OF BOARDS REQUIRED PER 100 SQ. FT.
(SQUARE EDGE BOARDS LAID SOLID)

Nominal Size	Actual Size	Add for Scant Width	Add for End Waste	Bd. Ft. Required Per 100 Sq. Ft.
1 x 4	3/4 x 3 5/8	14%	5%	119
1 x 6	3/4 x 5 5/8	9%	5%	114
1 x 8	3/4 x 7 1/2	10%	5%	115
1 x 10	3/4 x 9 1/2	8%	5%	113

ESTIMATING LABOR HOURS:

		Labor Hours	
		Skilled	Common
Sills (bolted & grouted in place)	Per 100 lin. ft.	3	2
Joist (2" x 4")	Per 1000 bd. ft.	20	8
" (2" x 6")	" " " "	18	7
" (2" x 8")	" " " "	16	6
" (2" x 10")	" " " "	15	5
Built-up Girders	" " " "	13	5
Rafters (2" x 6" or 2" x 8") Plain Gables	" " " "	23	6
" (2" x 10") Plain Gables	" " " "	21	6
" Hip Roofs (No dormers or Gables)	" " " "	26	7

ROUGH CARPENTRY

ESTIMATING LABOR HOURS: (Cont.)

		Labor Hours	
		Skilled	Common
Rafters Hip Roofs (With Dormers & Gables)	Per 1000 bd. ft.	38	8
Frame & Install Roof Trusses (20' to 40')	" " " "	23	7
Joist Bridging (1" x 3" or 1"x4")	Per 100 pcs.	4	-
Exterior Wall Studding & Plates	Per 1000 bd. ft.	21	6
Partition Studding & Plates	" " " "	20	5
Rafter Bracing & Ties	" " " "	20	5
Wall Bridging (Solid Blocking)	" " " "	50	-
Sub-Flooring (Diagonal)	" " " "	12	5
" " (Right Angle)	" " " "	10	5
Wall Sheathing (1" x 6" or 1" x 8" Diagonal)	" " " "	15	5
Wall Sheathing (1" x 6" or 1" x 8" Horizontal)	" " " "	12	5
Plywood or Composition Sheathing	" " " "	9	4
Roof Sheathing (Plain Gables)	" " " "	13	6
Roof Sheathing (Areas Cut by Hips, Valleys, etc.)	" " " "	16	7
Roof Sheathing (Spaced - Plain Gables)	" " "	14	7
Building Paper (Side Walls & Roof)	Per 500 sq.ft. roll	2	-
Furring Strips	Per 100 lin. ft.	1.5	.5

ROUGH CARPENTRY

ESTIMATING LABOR HOURS: (Cont.)

TABLE 15

APPROXIMATE MAN-HOURS REQUIRED PER 1000 BD. FT. FOR ALL FRAMING LUMBER

Type of House	Framing Man-Hours		Sub-Floor, Wall & Roof Sheathing Man-Hours		Total Man-Hours	
	Skilled	Common	Skilled	Common	Skilled	Comror
Plain Gable Roof Per 1000 bd.ft.	20	5	13	5	33	10
Hip Roof (No Dorners or Gables) " " " "	21	5	14	5	35	10
Hip Roof (With Dormers & Gables) " " " "	22	6	15	6	37	12

TABLE 16

APPROXIMATE MAN-HOURS PER SQ. FT. OF HOUSE FOR ALL FRAMING (INCLUDING SUB-FLOORING, WALL, & ROOF SHEATHING)

Type of House	Number of Bd.Ft. of Framing per Sq.Ft. of House	Number of Man-Hrs Per Sq.Ft. of House	
		Skilled	Common
One-Story Rectangular - Plain Gable Roof	9.8	.16	.05
" " - Hip Roof (No Dormers or Gables)	10.4	.17	.05
" " - Hip Roof (With Dormers & Gables)	11.0	.18	.06

Example: To determine the number of man-hours required to frame a house (including sub-floor, wall, and roof sheathing) that has an over-all area of 1200 sq. ft. - the house is one-story, rectangular with a plain gable roof:

For skilled labor, multiply 1200 sq. ft. x .16 = 192 man-hours

For common labor, multiply 1200 sq. ft. x .05 = 60 man-hours

ROUGH CARPENTRY

ESTIMATING COSTS:

The most accurate way to estimate the cost of rough carpentry is to take off the quantity of materials and the number of labor hours required for each operation. This would include the sills, girders, floor and ceiling joists, bridging, studs, plates, rafters, bracing, etc. A satisfactory degree of accuracy may be obtained in estimating the cost of rough carpentry by the use of the constants shown in Table 16. These constants were developed from the actual take-off of the quantities of framing lumber required in nine Farmers Home Administration standard house plans.

The following examples will illustrate both methods:

Example of estimating the quantities of materials and labor in the framing of a one-story house - approximately 1,355 sq. ft., by taking off each item of material and labor:

Description of Item		Material				Labor					Total Cost Material & Labor
						Skilled		Common			
		Unit	Approx. Quan.	Unit Cost	Total Cost	Hours	Cost Hour	Hours	Cost Hour	Total Cost	
4" x 4"											
Stair Post & Newel	1 pc. @ 12'0"	Bd.Ft.	16	___	___	.3	___	.1	___	___	___
Rear Porch Posts	2 pcs. @ 8'0"	" "	22	___	___	.5	___	.1	___	___	___
2" x 12"											
Front Porch Beams	4 pcs. @ 16'0"	Bd.Ft.	128	___	___	1.7	___	.6	___	___	___
Front Porch Beams	2 pcs. @ 12'0"	" "	48	___	___	.1	___	.3	___	___	___
2" x 10"											
Ceiling Girder	3 pcs. @ 18'0"	Bd.Ft.	90	___	___	.1	___	.1	___	___	___
Floor Jsts.Hdrs.&Carriages	41 pcs. @ 14'0"	" "	957	___	___	14	___	5	___	___	___
Jsts. Hdrs. & Trimmers	19 pcs. @ 12'0"	" "	380	___	___	6	___	2	___	___	___
Floor, Girder & Headers	17 pcs. @ 12'0"	" "	340	___	___	5	___	2	___	___	___
2" x 8"											
Valley Rafters, Ceiling Joists, & Lintels	29 pcs. @ 14'0"	Bd.Ft.	593	___	___	9	___	4	___	___	___
2" x 6"											
Rafters & Girders	26 pcs. @ 18'0"	Bd.Ft.	468	___	___	11	___	3	___	___	___
[illegible]	29 pcs. @ 16'0"	" "	464	___	___	11	___	[illegible]	___	___	___

ESTIMATING COSTS: (Cont.)

Description of Item		Material Unit	Material Approx. Quan.	Material Unit Cost	Material Total Cost	Labor Skilled Hours	Labor Skilled Cost Hours	Labor Common Hours	Labor Common Cost Hours	Labor Total Cost	Total Cost Material & Labor
2" x 6" (Cont.)											
Stair Platform & Brace	1 pc. @ 16'0"	Bd.Ft.	16	____	____						
Sills & Ceiling Joists	46 pcs. @ 12'0"	" "	552	____	____						
Pch. Trellis, Studs, Plts.	13 pcs. @ 8'0"	" "	104	____	____	12	____	5	____	____	____
2" x 4"											
Handrail - Stair	1 pc. @ 16'0"	Bd.Ft.	11	____	____		____		____	____	____
Sills, Plates, Sub-Sills, & Lintels	28 pcs. @ 14'0"	Bd.Ft.	262	____	____		____		____	____	____
	45 pcs. @ 12'0"	" "	360	____	____		____		____	____	____
	30 pcs. @ 10'0"	" "	201	____	____		____		____	____	____
	10 pcs. @ 8'0"	" "	53	____	____		____		____	____	____
Braces (Roof & Int. Part.)	35 pcs. @ 12'0"	" "	280	____	____	67	____	19	____	____	____
Rear Porch Roof	8 pcs. @ 12'0"	" "	64	____	____		____		____	____	____
Outlookers & Blocking	13 pcs. @ 10'0"	" "	87	____	____		____		____	____	____
Studs	361 pcs. @ 8'0"	" "	1907	____	____		____		____	____	____
1" x 8"											
Ridge Board	5 pcs. @ 14'0"	Bd.Ft.	47	____	____	1	____	.3	____	____	____
1" x 6"											
Diag. Sheathing, T.&G.R/L		Bd.Ft.	1608	____	____	24	____	8	____	____	____
Sub-Flooring, S.F. R/L		" "	1270	____	____	13	____	6	____	____	____
Sheathing, T.&G. R/L		" "	2043	____	____	27	____	13	____	____	____
Collar Beams	11 pcs. @ 10'0"	" "	55	____	____	1	____	.5	____	____	____
1" x 4"											
Bridging, R/L	210 lin. ft.	Bd.Ft.	70	____	____	6	____	-	____	____	____
	Total		12,566			210		72			

ESTIMATING COSTS (Cont.)

Example of estimating the quantities of materials and labor in the framing of a one-story house - approximately 1,355 sq. ft. by using the constants in Table 16:

From Table 12 obtain the constant for the number of board feet of framing and the hours of skilled and common labor for a rectangular house with plain gable roof. Multiply the number of square feet by the constant and multiply the result by the unit cost or rate per hour.

	Unit Cost or Rate per Hour	Total Cost
Framing 1355 x 9.8 = 13,279 bd. ft. x	_____	_____
Skilled Labor 1355 x .16 = 217 hours x	_____	_____
Common Labor 1355 x .05 = 68 hours x	_____	_____
Total Material and Labor		_____

SIDING

ESTIMATING QUANTITIES:

Wood:

QUANTITY OF SIDING PER 100 SQ. FT. OF WALL

Type	Nominal Size	Actual Size	Exposed to Weather	Add for Lap	Add For End Cutting & Waste	Bd.Ft. Required Per 100 Sq.Ft. of Surface
Drop	1" x 6"	3/4" x 5 7/16"	5 1/16"	15%	5%	120
Drop	1" x 8"	3/4" x 7 3/16"	6 11/16"	12%	5%	117
Bevel	1/2" x 6"	1/2" x 5 1/2"	4 3/4"	26%	5%	131
Bevel	5/8" x 8"	5/8" x 7 1/4"	6 3/4"	18%	5%	123

Asbestos Siding: 12" x 24", 10½" x 24" - 57 pieces per 100 sq. ft.

SIDING

ESTIMATING LABOR HOURS:

		Labor Hours Skilled	Common
6" Drop Siding	Per 1000 sq. ft.	21	-
8" " "	" " " "	19	-
6" Bevel Siding	" " " "	22	-
8" " "	" " " "	20	-
Asbestos	Per 100 sq. ft.	4	-

ESTIMATING COSTS:

1" x 6" Drop Siding Wall Per 100 Sq. Ft.		Rate per Hour or Unit Cost	Total Cost
1" x 6" Drop Siding	120 bd. ft.	_____	_____
Skilled Labor	2.1 hours	_____	_____
	Cost per 100 sq. ft.		_____
	Cost per sq. ft.		_____

ROOFING

ESTIMATING QUANTITIES:

To obtain the area of a plain gable roof, multiply the length of the ridge by the length of the rafter, this will give you one-half of the roof. Multiply this by 2 to obtain the total square feet of roof surface.

To obtain the area of a hip roof, multiply the length of the eaves by 1/2 of the length of the rafter, then multiply this by 2, this will give the area of both ends. To get the sides, add the length of the eave to the length of the ridge and divide by 2. Multiply this by the length of the rafter, this gives the area of one side of the roof, and when multiplied by 2 gives the number of square feet on both sides of the roof. Add this to the area of the two ends and divide the total area by 100 to get the number of squares.

The area of a plain hip roof running to a point at the top is obtained by multiplying the length of eaves at one end by 1/2, the length of the rafter. This gives the area of one end of the roof. To obtain the area of all four sides, multiply by 4.

ESTIMATING QUANTITIES: (Cont.)

Asphalt Shingles:

Asphalt shingles come in various sizes. The most common size is 12" x 36", 3 tabs per shingle, with 5" exposure. It takes 80 shingles per square, or 3 bundles of shingles per square.

When measuring roofs of any shape always allow one extra course of shingles for the "starters" at the eaves. Obtain the number of linear feet of hips, valleys and ridges to be covered with asphalt shingles and compute same as 1 foot wide. Three quarters of a pound of 7/8" nails per square will be required.

Wood Shingles:

Wood shingles are manufactured in three lengths: 16-inch, 18-inch, and 24-inch. The standard exposure (for roof having a pitch of 5 in 12 or over) is 5" for 16" shingles, 5 1/2" for 18" shingles, and 7 1/2" for 24" shingles. Ordinarily wood shingles are furnished in random widths; however, 1000 shingles are equivalent to 1000 shingles 4" wide.

One 4" wide shingle when exposed 5" to the weather will cover 20 square inches. There are 144 square inches in a square foot. By dividing 20 into 144, we get 7.2 shingles per square foot. There are 100 square feet to a square, 100 x 7.2 = 720, and allowing 10 percent to cover the double row of shingles at the eaves, waste in cutting, narrow shingles, etc., it will require 792 shingles per 100 square feet of surface.

QUANTITY OF SHINGLES PER 100 SQ. FT. OF ROOF

Exposure	Area Covered by One Shingle Sq. In.	Percent to Add for Waste	Actual Number Per Square Without Waste	Number per Square With Waste
5	20	10	720	792
5 1/2	22	10	655	720

Galvanized Metal: (V-Crimp or Corrugated)

V-crimped roofing is usually furnished in sheets covering 24 inches in width and 6 to 10 feet long. When estimating quantities, allow for the end lap but there is no waste in the width.

ROOFING

ESTIMATING QUANTITIES: (Cont.)

Galvanized Metal: (V-Crimp or Corrugated)(Cont.)

The following table gives the quantity of V-crimp roofing required to cover 100 sq. ft. of roof with end laps 1" to 6":

TABLE 17

SQ. FT. OF V-CRIMP ROOFING REQUIRED PER 100 SQ. FT. OF ROOF

Sheet Length in Feet	End Lap in Inches					
	1	2	3	4	5	6
6	102	103	105	106	108	109
7	102	103	104	105	106	108
8	101	102	103	104	106	107
9	101	102	103	104	105	105
10	101	102	103	104	105	105

Corrugated Roofing and Siding:

Corrugated roofing and siding is made with 5/8", 1 1/4", 2 1/2", and 3" corrugations, but the 1 1/4" and 2 1/2" corrugations are most commonly used. Sheets are usually furnished 26" wide and 6' to 10' long, but the 8' length is probably the most frequently used.

TABLE 16

NUMBER OF SQ. FT. OF CORRUGATED SHEETS
REQUIRED TO COVER 100 SQ. FT. OF SURFACE
USING 26" x 96" SHEETS

2 1/2 corrugations	Length of End Lap in Inches					
	1	2	3	4	5	6
	Square Feet of Corrugated Metal					
Side lap, 1 corrugations	110	111	112	113	114	115
" " 1 1/2 "	116	117	118	119	120	121
" " 2 "	123	124	125	126	127	128
" " 2 1/2 "	130	131	132	133	134	135
" " 3 "	138	139	140	141	142	143

ROOFING

ESTIMATING LABOR HOURS:

Roofing:		No. of Hours Skilled Labor
Asphalt Shingles (strip)	Per 100 sq. ft.	2.3
Asphalt Shingles (individual)	" " " "	3
Wood Shingles	" " " "	3.5
Asbestos Cement Shingles	" " " "	4
Built-Up, 3-Ply	" " " "	3
Metal (V-Crimp or Corrugated)	" " " "	2.2

ESTIMATING COSTS:

Example:

100 square feet of roof surface, plain gable asphalt shingles (strip), 3 tabs, 12" x 36":

		Unit Price or Rate per Hour		Cost
80 Shingles - 3 Bundles	x	_____	=	_____
Skilled Labor 2.3 Hours	x	_____	=	_____
		Cost per 100 sq. ft.		_____
		Cost per sq. ft.		_____

SHEET METAL

ESTIMATING QUANTITIES:

Gutter:

Metal gutters are furnished in numerous designs and sizes. When estimating quantities, give the size and length.

Downspouts:

Metal downspouts are furnished in both round and rectangular, in vario sizes. When estimating quantities give the size and length. Measure distance from the roof to the ground.

SHEET METAL

ESTIMATING QUANTITIES: (Cont.)

Valley Flashing:

Metal valley flashing is usually about 18" wide. When estimating quantities, measure the length of the valley and multiply by the width.

Flashing and Counter Flashing:

Flashing is usually made from strips of metal 12" wide, and is used at chimney and roof intersections or wall and roof intersections. Measure lineal feet of surface to be flashed and multiply by 2 for base and counter flashing.

ESTIMATING LABOR HOURS:

		No. of Hours Skilled Labor
Gutters	Per 100 lin. ft.	8
Downspouts	" " " "	5
Valley Flashing	" " " "	12
Base & Counter Flashing	" " " "	30

ESTIMATING COSTS:

Example: To estimate the cost of 100 lin. ft. of valley flashing 18" wide:

100 lin. ft. x 1.5 = 150 sq. ft.

		Unit Price or Rate per Hour		Cost
150 sq. ft. metal flashing	x	_____	=	_____
Skilled labor 12 hours	x	_____	=	_____
Cost per 100 lin. ft.				_____
Cost per lin. ft.				_____

FLOORING

ESTIMATING QUANTITIES:

When estimating the quantity of wood flooring required, take the actual number of square feet in any room or space to be floored and add allowances as given in the following tables:

TABLE 17

Nominal Size	Finished Size	Add Percent for Waste or Multiply Area by	No. of Sq. Ft. Required for 100 Sq. Ft. of Floor
1 x 3	$\frac{13}{16}$ x 2 1/4	33 1/3 — 1.33	133
1 x 4	$\frac{13}{16}$ x 3 1/4	25 — 1.25	125

TABLE 18

AMOUNT OF SURFACE 1000 FT. OF FLOORING WILL COVER

Size of Flooring	Finished Size of Flooring	Will Cover Sq.Ft. of Floor
1 x 3	$\frac{13}{16}$ x 2 1/4	750
1 x 4	$\frac{13}{16}$ x 3 1/4	800

ESTIMATING LABOR HOURS:

	Labor Hours Skilled	Common
Laying Hardwood Floors - 1 1/2" face Per 100 bd. ft.	34	5
" " " 2 1/4" " " " " "	24	4
Laying Softwood Floors 3 1/4" face " " " "	15	4
Sanding Floors (by machine) " " " "	2	-
Laying Asphalt Tile (9" x 9") " " " "	3	-
Laying Rubber Tile (6" x 6") " " " "	4	-

FLOORING

ESTIMATING COSTS:

Example: To estimate the cost of flooring on an area of 100 sq. ft. - using 2 1/4" hardwood flooring:

	Hours		Rate per Hour or Unit Cost	Total
2 1/4" Flooring - 133 bd. ft.		x	_____	_____
Skilled Labor - Laying Flooring	3.2	x	_____	_____
Common Labor - " "	.5	x	_____	_____
Skilled Labor - Sanding	2.0	x	_____	_____
Cost per 100 sq. ft.				_____
Cost per sq. ft.				_____

INTERIOR WALLS AND CEILINGS

ESTIMATING QUANTITIES:

Wallboard:

To estimate the number of square feet of wall and ceiling area to be covered, it will be helpful to make a sketch of the walls and ceiling (room by room), showing the window and door openings, etc., and dimensions of the room. The tape and joint material to be used in the installation of the wallboard must also be estimated.

SIZES AND THICKNESSES OF GYPSUM WALLBOARD

Thickness	Width	Length
1/4"	48"	4' to 12'
3/8"	48"	4' to 12'
1/2"	48"	4' to 12'

Estimate about 1 1/2 boxes, or 375 lineal feet of tape, and two 5 lb. boxes of filler per 1000 sq. ft. of wallboard.

INTERIOR WALLS AND CEILINGS

ESTIMATING QUANTITIES: (Cont.)

Plaster Walls:

Plastering is estimated by the square yard, which is obtained by multiplying the girth of the room by the height, plus the area of the ceiling. Openings, less than 2 ft. wide should not be deducted. One-half of the area of openings over two ft. wide should be deducted. There are a number of types of lath that may be used, probably, the most commonly used type is gypsum lath.

Gypsum lath comes in sheets 16" x 32" or 16" x 48", 6 laths to the bundle.

32" laths contain 23 1/3 sq. ft.
48" laths contain 32 sq. ft.

TABLE 18

NUMBER OF 100 LB. SACKS OF PREPARED PLASTER (SANDED) REQUIRED PER 100 SQ. YDS. OF SURFACE (PLASTER 1/2" THICK)

Metal Lath	Gypsum Lath	Masonry
50	26	40
For each 1/8" thickness, add or deduct sacks -		
12.5	6 1/2	10

TABLE 19

NUMBER OF 100 LB. SACKS OF PREPARED FINISHING PLASTER REQUIRED PER 100 SQ. YDS. OF SURFACE (1/8" FINISH)

Sand Float Finish	Prepared Trowel Float Finish	Keene's Cement Finish
7.6	5.7	4.5

ESTIMATING LABOR HOURS:

		Labor Hours Skilled	Common
Placing Gypsum Wallboard	Per 100 sq. ft.	2.5	-
Tape and Fill Joints	" " " "	1.0	-
Placing Plastic Wall Tile (4" x 4")	" " " "	8.0	-
Wood Sidewalls (D. & M. Boards)	Per 1000 bd. ft.	30.0	-

INTERIOR WALLS AND CEILINGS

ESTIMATING LABOR HOURS: (Cont.)

		Labor Hours Skilled	Common
Wood Ceiling (D. & M. Boards)	Per 1000 bd. ft.	36.0	-
Metal Lath	Per 100 sq. yds.	9.0	-
Gypsum Lath	" " " "	9.0	-
Metal Corner Beads	Per 100 lin. ft.	4.0	-
Metal Cornerites or Metal Lath Angle Strips	" " " "	3.0	-
Plaster, 2-Coat, White Finish	Per 100 sq. yds.	13.0	10
Plaster, 3-Coat, White Finish	" " " "	18.0	14
Plaster, 2-Coat, Keene's Cement Finish	" " " "	17.0	13
Plaster, 3-Coat, " " " " " " "		22.0	15

ESTIMATING COSTS:

Example: To estimate the cost of 100 sq. yds. of plastered wall 1/2" Thick, with 1/8" White Trowel Finish on Gypsum Lath:

		Hours	Rate per Hour or Unit Cost	Total
Gypsum Lath	100 sq. yds.	____	_____	_____
Plaster (Sanded)	26 sacks	____	_____	_____
Finish Plaster	5.7 sacks	____	_____	_____
Plasterer		18	_____	_____
Plasterer's Helper		14	_____	_____
	Cost per 100 sq. yds.			_____
	Cost per sq. yd.			_____

INTERIOR WALLS AND CEILINGS

ESTIMATING COSTS: (Cont.)

Example: To estimate the cost of 100 sq. ft. of 3/8" gypsum wallboard wall.

		Hours	Rate per Hour or Unit Cost	Total
Wallboard	100 sq. ft.	____	_____	_____
Tape	37.5 ft.	____	_____	_____
Filler	.5 lb.	____	_____	_____
Skilled Labor		2.5	_____	_____
		Cost per 100 sq. ft.		_____
		Cost per sq. ft.		_____

WINDOWS, DOORS, EXTERIOR AND INTERIOR TRIM AND OTHER MILLWORK

ESTIMATING LABOR HOURS:

		Labor Hours	
Windows: (Including Frame, Sash, Trim, and Hardware)		Skilled	Common
Double Hung or Casement (Factory Assembled)	Each	2.5	-
Double Hung or Casement (Knocked Down)	"	4.0	-
Window Screens	"	1.0	-
Storm Windows	"	1.0	-
Shutters, Factory-Built - Fixed	Pair	1.0	-
Shutters " " - Hinged	"	2.0	-
Shutters, Job-Built - Fixed	"	3.0	-
" " - Hinged	"	4.0	-
Doors: (Including Frame, Trim, and Hardware)			
Exterior	Each	5.5	-
Interior	"	4.0	-
Weatherstripping (Single Door Including Threshold)	"	1.5	-
Screen Door (Including Hardware)	"	1.5	-

WINDOWS, DOORS, EXTERIOR AND INTERIOR TRIM AND OTHER MILLWORK

ESTIMATING LABOR HOURS: (Cont.)		Labor Hours Skilled	Common
Combination Door & Screen Door	Each	2.0	-
Cased Opening	"	2.0	-
Exterior Trim:			
Corner Boards, Verge, Facia, etc.	Per 100 lin. ft.	4.0	-
Cornice (3-Member)	" " " "	12.0	-
Porch Post (Plain)	Each	1.0	-
Porch Post (Built-Up)	"	2.0	-
Baseboard:			
1-Member	Per 100 lin. ft.	5.0	-
2-Member	" " " "	7.0	-
3-Member	" " " "	9.0	-
Cabinet Work:			
Base Section, Job-Built	Per lin. ft.	3.5	-
Wall Section, Job-Built	Per sq. ft.	1.0	-
Install Factory-Built Base Sections	Per 3 ft. wide unit	2.0	-
" " " Wall "	" " " " "	2.0	-
" " " Medicine Cabinet	Each	1.0	-
Clothes Closet:			
1 Shelf, Hookstrip, Hook & Pole	Each	2.0	-
Open Shelving & Cleats	"	.5	-
Linen Closet - Shelving & Cleats	"	3.0	-
Stair Work:			
Basement Stairs (Open Risers - Straight Run with Handrails)	Each	8.0	-
Basement Stairs (One Intermediate Landing)	"	11.0	-

WINDOWS, DOORS, EXTERIOR AND INTERIOR TRIM AND OTHER MILLWORK

ESTIMATING LABOR HOURS: (Cont.)

		Labor Hours Skilled	Common
Stair Work: (Cont.)			
Main Stairs, Job-Cut (Straight Run with Plain Handrails)	Each	20.0	-
Main Stairs, Mill-Cut (Straight Run with Plain Handrails)	"	10.0	-
Main Stairs, Job-Cut (Complete with Newels, Handrails, & Balusters)	"	26.0	-
Handrails & Balusters (Horizontal Run)	Per lin. ft.	.4	-
Install Disappearing Stair	Each	5.0	-

NAILS

ESTIMATING QUANTITIES:

Size and Kind of Material	Size and Kind of Nail	Pounds per 1000 Bd. Ft.	Number Per Lb.
1 x 2	6 d Common	15	181
1 x 4	8 d "	48	106
1 x 6	8 d "	32	106
1 x 8	8 d "	27	106
1 x 10	8 d "	20	106
2 x 4, 2 x 6, 2 x 8, 2 x 10, 2 x 12 (Framing)	20 d "	16	31
	16 d "	10	49
	10 d	6	69
1 x 6 Drop Siding	8 d Casing	25	145
1 x 8 " "	8 d "	18	145
1/2 x 6 Bevel Siding	6 d Finish	13	309
1/2 x 8 " "	6 d "	10	309
1 x 3 Flooring	8 d Floor	32	99

NAILS

ESTIMATING QUANTITIES: (Cont.)

Size and Kind of Material	Size and Kind of Nail	Pounds per 1000 Bd. Ft.	Number per Lb.
1" x 4" Flooring	8 d Floor	26	99
3/4 "x 4" Ceiling	8 d Finish	14	189
1/2" x 5/8" "	6 d "	8	309
7/8" Finish Lumber	8 d "	12	189
1 1/8" " "	10 d "	10	121
3/8" Gypsum Wallboard	3 d Blued Plaster Bd.	8	568
1/2" " "	3 d " " "	11	568
		Pounds per Square	
3-Tab Asphalt Shingles	7/8" Roofing	3/4	469
Wood Shingles	3 d Roofing	3	429
" "	4 d "	5 1/4	274
Baseboard	8 d (Per 100 lin.ft.)	1	189
		Pounds per 100 Sq.Yds.	
Gypsum Lath	3 d Blued Plaster Board	8	568

PAINTING

ESTIMATING QUANTITIES:

When estimating quantities of painting or interior finishing, the actual surface to be painted should be measured as accurately as possible.

SPREADING RATES

Type of Paint	Type of Surface	Surface Covered by 1 Gallon: 1 Coat Sq. Ft.	2 Coats Sq. Ft.	3 Coats Sq. Ft.
Oil paint - gloss finish	Smooth wood	600	325	225
	Rough wood	350	200	135
	Plaster	450	250	175
	Brick	400	225	160
	Concrete	350	200	150
Oil paint - flat finish	Smooth wood	500	275	200
	Wallboard	500	275	200
	Plaster	400	225	160
	Concrete	300	175	125
Shingle Stain*	Rough wood	125	75	
Enamel	Smooth wood	500	250	
Varnish	" "	450	250	175
Shellac	" "	600	300	
Floor sealer	" "	900		
Floor wax, liquid	" "	4000		
Floor wax, paste	" "	300 (per lb.)		

* 2 1/2 gallons per 1000 shingles when dipped 2/3 of their length.

PAINTING

ESTIMATING QUANTITIES: (Cont.)

The following may be used as a guide in measuring and estimating paint quantities:

Bevel or Drop Siding Walls: Obtain actual area of all walls and gables. Add 10 percent to actual surface measurement to allow for painting under edge of boards. Do not deduct for openings less than 10' x 10'.

Brick, Wood, Stucco, Cement, and Stone Walls: Obtain actual area of all walls and gables. Do not deduct for openings less than 10'-0" x 10'-0".

Eaves: Plain eaves painted same colors as side walls, obtain area and multiply by 1 1/2. If eaves are painted a different color than side walls, obtain area and multiply by 2.

Eaves with rafters running through, obtain area and multiply by 3.

Eaves over brick, stucco or stone walls, obtain area and multiply by 3.

Cornices, Exterior: Plain cornices, obtain area and multiply by 2. Fancy cornices or cornices containing dentils, etc., obtain area and multiply by 3.

Doors and Frames, Exterior: Inasmuch as it costs almost as much to paint a small door as a large one, do not figure any door less than 3'-0" x 7'-0": allowing for frame, add 2'-0" to the width and 1'-0" to the height. For instance, a 3'-0" x 7'-0" door would be figured as 5'-0" x 8'-0", or 40 sq. ft.

If a sash door, containing small lights of glass, add 1 1/2 sq. ft. for each additional light. A 4-light door would contain 6 sq. ft. additional; a 12-light door, 18 sq. ft. additional, etc.

If painted on both sides, obtain sq. ft. area of one side and multiply by 2.

Door frames only, where no door is hung, allow area of opening to take care of both sides.

Window, Exterior: Inasmuch as it costs almost as much to paint a small window as a large one, do not figure any window less than 3'-0" x 6'-0". Add 2'-0" to both the width and height of the openings to take care of the sides and head of the frame and the outside casing or brick mold, and multiply to obtain the area. For instance, a window opening 3'-0" x 6'-0", add 2'-0" to both the width and height, making 5'-0" x 8'-0", containing 40 sq. ft. of surface.

If sash contain more than one light each, such as casement sash, etc., add 1 1/2 sq. ft. for each additional light. A 6-light window, 18 sq. ft. additional, etc.

PAINTING

ESTIMATING QUANTITIES: (Cont.)

Wood Base: Wood or metal base under 1'-0" high should be figured as 1'-0" high.

Interior Doors, Jambs and Casings: When estimating quantities for interior doors, jambs and casings, add 2'-0" to the width and 1'-0" to the height of the opening. This allows for painting or varnishing the edges of the door, the door jambs which are usually 6" wide, and the casings on each side of the door which average from 4" to 6" wide.

Example: On a 3'-0" x 7'-0" door opening, add 2'-0" to the width and 1'-0" to the height, which gives an opening 5'-0" x 8'-0", containing 40 sq. ft. on each side. Some painters figure all single doors at 40 sq. ft. per side, or 80 sq. ft. for both sides, while others figure them at 50 sq. ft. per side, or 100 sq. ft. for both sides. Do not deduct for glass in doors.

If a sash door, containing small lights of glass, add 1 1/2 sq. ft. for each additional light. A 4-light door would contain 6 sq. ft. additional; a 12-light door, 18 sq. ft. additional, etc.

Interior Windows, Jamb Linings, Sash and Casings: When estimating painting quantities for windows and window trim, add 2'-0" to the sides and length to allow for jamb linings, casing at the top and sides, and window stool and apron at the bottom.

Example: If the window opening is 3'-0" x 6'-0", adding 2'-0" to both the width and length gives a window 5'-0" x 8'-0", containing 40 sq. ft. of surface.

If sash contain more than one light each, such as casement sash, etc. add 1 1/2 sq. ft. for each additional light. A 6-light window would contain 9 sq. ft. additional; a 12-light window, 18 sq. ft. additiona etc.

Plastered Walls and Ceilings: To obtain the area of any ceiling, multiply the length by the breadth, and the result will be the numbe of square feet of ceiling.

When estimating walls, measure the entire distance around the room and multiply by the room height. The result will be the number of square feet of wall to be decorated. For instance, a 12'-0" x 15'-0" room has two sides 12'-0" long, and two sides 15'-0" long, giving a total of 54 lin. ft. If the ceilings are 9'-0" high, 54 x 9 = 48 sq. ft. - the area of the walls.

Do not deduct for door and window openings.

PAINTING

ESTIMATING LABOR HOURS:

Exterior:		Labor Hours Skilled	Common
Wood - Plain Surfaces (Priming Coat)	Per 100 sq. ft.	.6	-
Wood - Plain Surfaces (2nd or 3rd Coat)	" " " "	.7	-
Wood - Plain Surfaces (2 Coats - Priming & 2nd Coat)	" " " "	1.3	-
Wood - Plain Surfaces (3 Coats - Priming, 2nd, & 3rd Coats)	" " " "	2.0	-
Wood - Doors, Windows, Frames Casing, etc. (Priming Coat)	" " " "	1.2	-
Wood - Doors, Windows, Trim, etc. (2nd or 3rd Coat)	" " " "	1.4	-
Wood - Doors, Windows, Frames, Casings, etc. (2 Coats)	" " " "	2.6	-
Wood - Doors, Windows, Frames, Casings, etc. (3 Coats)	" " " "	4.0	-
Average 12-Light Window (2 Coats)	" " " "	1.5	-
Average 12-Light Window (3 Coats)	" " " "	2.3	-
Interior:			
Priming Coat - Doors, Door & Window Trim, Baseboard, etc.	Per 100 sq. ft.	.8	-
Doors, Door & Window Trim, Baseboard, etc. (2nd & 3rd Coats)	" " " "	.9	-
Enamel - Doors, Door & Window Trim, Baseboard, etc.	" " " "	1.0	-
Sanding Interior Trim Between Coats	" " " "	.5	-
Filling Interior Trim	" " " "	1.4	-
Staining Interior Trim	" " " "	.8	-
Shellac Interior Trim	" " " "	.7	-
Varnish Interior Trim	" " " "	.8	-

ESTIMATING LABOR HOURS: (Cont.)

Interior: (Cont.)

		Labor Hours Skilled	Common
Sizing Plaster Walls	Per 100 sq. ft.	.4	-
One Coat Lead & Oil or Flat Wall Paint - Plaster Walls	" " " "	.6	-
One Coat Lead & Oil or Flat Wall Paint - Wallboard	" " " "	.7	-

Floors:

Sanding Floors	Per 100 sq. ft.	2.0	-
Paste Filler (Including Removal of Surplus Filler)	" " " "	.9	-
Shellac (Each Coat)	" " " "	.4	-
Varnish (Each Coat)	" " " "	.5	-
Sealer	" " " "	.3	-
Paste Wax	" " " "	.5	-
Polishing	" " " "	.7	-

ESTIMATING COST:

Example: To estimate the cost of painting 100 sq. ft. of drop siding with three coats of oil paint:

In estimating the quantities of paint required to paint drop siding, we add 10 percent to the area for painting the edges; therefore, the area would be 100 sq. ft.

	Labor Hours or Quantity	Rate per Hour or Unit Cost	Total
Oil Paint	1/2 Gal.	_____	_____
Painter	2 hours	_____	_____
		Cost per 100 sq. ft.	_____
		Cost per sq. ft.	_____

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